Patent Claims

1. An optical arrangement for illumination purposes, in particular for a stepped lens spotlight, comprising a stepped lens with a light-diffusing element, in particular a diffusing screen, in which the diffusing screen is arranged in a first region and the stepped lens is arranged in a second region, and in which, with the change in the shape of the light impinging on the optical arrangement and/or the size of the light illuminating the optical arrangement, it is possible to set the aperture angle of the light emerging from the optical arrangement, in particular between two limit values, a smaller α_{Sp} and a larger α_{F1}.

2. The optical arrangement as claimed in claim 1, wherein the first and second regions in each case occupy surfaces of the optical arrangement, preferably concentrically arranged surfaces having different diameters (2Rst1, 2RstrA).

3. The optical arrangement as claimed in claim 1 or 2, wherein, with the change in the size, in particular the diameter, of the light impinging on the optical arrangement, it is possible to alter, in particular set, the aperture angle (α, α_{Sp}, α_{F1}) of the light emerging from the optical arrangement essentially without altering the angle of incidence of the light illuminating the optical arrangement.

4. The optical arrangement as claimed in claim 1, 2 or 3, wherein the ratio of the surface size of the stepped lens surface to the diffusing screen surface is greater than 2 to 1, preferably the ratio of the surface size of the stepped lens surface to the diffusing screen surface is greater than 10 to 1, and most preferably the ratio of the surface size of

the stepped lens surface to the diffusing screen surface is greater than 100 to 1.

5. The optical arrangement as claimed in one of claims 1 to 4, wherein the aperture angle of the light emerging from the diffusing screen in a vertical direction is different from the aperture angle in a horizontal direction.

6. The optical arrangement as claimed in one of claims 1 to 5, wherein the diffusing screen contains a plurality of regions, in particular annular surface regions, which scatter light in each case in different directions or to different extents.

7. The optical arrangement as claimed in one of claims 1 to 5, wherein, for a stepped lens spotlight having an elliptic reflector having an ellipticity ε, the ratio of the focal length to the radius $n_{st1} = R_{St1}/F_{St1}$ of the stepped lens is greater than 0.5 times $1/\mathrm{sqrt}(\varepsilon^2-1)$, preferably greater than 0.7 times $1/\mathrm{sqrt}(\varepsilon^2-1)$, most preferably greater than 0.9 times $1/\mathrm{sqrt}(\varepsilon^2-1)$.

8. The optical arrangement as claimed in one of the preceding claims, wherein the diffusing screen is arranged only in a central and/or centric region of the stepped lens.

9. The optical arrangement as claimed in one of the preceding claims, wherein the diffusing screen is arranged at the light exit area.

10. The optical arrangement as claimed in one of the preceding claims, wherein the diffusing screen is arranged at

the light entry area.

11. The optical arrangement as claimed in one of the preceding claims, wherein a diffusing screen is in each case arranged at the light entry area and at the light exit area.

12. The optical arrangement as claimed in one of the preceding claims, wherein the light-diffusing element has regions that diffuse to different extents, preferably a region that diffuses to a greater extent centrically and a region that diffuses to a lesser extent marginally.

13. The optical arrangement as claimed in one of the preceding claims, wherein the diffusing screen is produced in matted fashion and/or by hot-forming, in particular embossing and/or by injection molding.

14. The optical arrangement as claimed in one of the preceding claims, wherein the material of the stepped lens and/or of the diffusing screen comprises glass.

15. The optical arrangement as claimed in one of the preceding claims, wherein the material of the stepped lends and/or of the diffusing screen comprises glass-ceramic material, in particular consists of glass-ceramic material.

16. The optical arrangement as claimed in one of the preceding claims, wherein the optical arrangement is formed in one piece.

17. The optical arrangement as claimed in one of the preceding claims, wherein the stepped lens is an aspherical lens.

18. The optical arrangement as claimed in one of the claims from 1 to 11, wherein the stepped lens is a spherical lens.

19. The optical arrangement as claimed in one of the preceding claims, wherein the stepped lens has a basic body with an essentially plane surface.

20. The optical arrangement as claimed in one of the preceding claims, wherein the stepped lens has an optically beam-shapingly effective basic body with an essentially concave spherical or aspherical surface.

21. The optical arrangement as claimed in one of the preceding claims from 1 to 19, wherein the stepped lens has an optically beam-shapingly effective basic body with an essentially convex spherical or aspherical surface.

22. The optical arrangement as claimed in one of the preceding claims, wherein the essentially annular, optically effective surfaces of the steps are configured as circle-arc segments.

23. The optical arrangement as claimed in one of the preceding claims from 1 to 21, wherein the essentially annular, optically effective surfaces of the steps are formed in the shape of cone envelopes.

24. The optical arrangement as claimed in one of the preceding claims from 1 to 21, wherein the essentially annular, optically effective surfaces of the respective steps are shaped such that an approximately planar wave with phase fronts perpendicular to the optical axis is combined at a

real focal point or is converted into a spherical wave whose midpoint appears to lie at a virtual focal point.

25. The optical arrangement as claimed in one of the preceding claims, wherein the material of the stepped lens and/or of the diffusing screen comprises plastic.

26. The optical arrangement as claimed in one of the preceding claims, wherein the optical arrangement with stepped lens and diffusing screen is composed of a plurality of elements.

27. The optical arrangement as claimed in one of the preceding claims, wherein the optical arrangement is a hybrid composite made of glass and plastic.

28. The optical arrangement as claimed in one of the preceding claims, wherein the stepped lens comprises a material with a first dispersion behavior and a further lens with an opposite refractive power, preferably a stepped lens with a material with a second dispersion behavior, is provided in such a way that chromatic aberrations are reduced.

29. The optical arrangement as claimed in one of the preceding claims, wherein the stepped lens is an embossed lens, in particular a plastic lens, preferably with an optical path length difference at the respective step of less than about 1000 optical wavelengths.

30. The optical arrangement as claimed in one of the preceding claims, wherein the stepped lens is formed or arranged on a first side and the diffusing screen is formed

or arranged on a side opposite to the first side.

31. The optical arrangement as claimed in one of the preceding claims, wherein the annular segments arranged around the central circular segment of the stepped lens essentially have the same radial extent.

32. The optical arrangement as claimed in one of the claims from 1 to 30, wherein the stepped elevations of at least two adjacent annular segments essentially have the same height.

33. The optical arrangement as claimed in one of the preceding claims, wherein at least that surface of the optical arrangement which faces the light source consists of glass and is prestressed, preferably thermally prestressed.

34. The optical arrangement as claimed in one of the preceding claims, wherein the stepped lens and/or the diffusing screen are/is formed as a filter, in particular as a UV, IR or colored bandpass filter and/or conversion filter.

35. The optical arrangement as claimed in one of the preceding claims, wherein the stepped lens and/or the diffusing screen are coated with a mechanical antiscratch layer and/or an antireflection layer.

36. A diffusing screen for an optical arrangement as claimed in one of the preceding claims, which has a first surface, which is subdivided into facets, and in the case of which each facet is assigned an elevation or depression with a second surface formed in curved fashion, wherein the facets assume different geometrical shapes.

37. The diffusing screen as claimed in claim 36, wherein the facets have a polygonal edge contour.

38. The diffusing screen as claimed in claim 36, wherein the facets contain different areas.

39. The diffusing screen as claimed in claim 36, 37 or 38, wherein the facets assume the shape of a triangle, quadrangle, pentagon, hexagon and/or heptagon.

40. The diffusing screen as claimed in one of claims 36 to 39, wherein the facets have different orientations.

41. The diffusing screen as claimed in one of claims 36 to 40, wherein the elevations or depressions are formed in the shape of spherical caps.

42. The diffusing screen as claimed in one of claims 36 to 41, wherein the height of the elevations and/or the depth of the depressions are chosen to be different.

43. The diffusing screen as claimed in the preamble of claim 36, wherein the respective vertices (S) of the elevations or depressions are arranged along a spiral.

44. The diffusing screen as claimed in claim 43, wherein the vertices (S) are arranged on an Archimedes' spiral.

45. The diffusing screen as claimed in claim 43 or 44, wherein the arc length (L) between two adjacent vertices (S) along the spiral is almost equidistant.

46. The diffusing screen as claimed in claim 43 or 44,

wherein the arc length (L) between two adjacent vertices (S) along the spiral is configured to be variable.

47. The diffusing screen as claimed in one of claims 43 to 46, wherein the height of the elevations and/or the depth of the depressions are chosen to be different.

48. The diffusing screen as claimed in the preamble of claim 36, wherein the diffusing screen has individual facets that are rotated relative to one another.

49. The diffusing screen as claimed in the preamble of claim 36, wherein the diffusing screen has facets that are offset from their regular position by means of a Monte Carlo method.

50. A diffusing screen for an optical arrangement as claimed in one of the preceding claims from 1 to 37, wherein the diffusing screen has a defined granularity which becomes finer in a central region and coarser with increasing distance from the center.

51. A stepped lens spotlight having an adjustable aperture angle of the emerging light bundle having a, preferably ellipsoidal, reflector, a lamp and at least one stepped lens, wherein the stepped lens has a diffusing screen and is, in particular, a stepped lens having a diffusing screen as claimed in one of the claims from 1 to 50.

52. The stepped lens spotlight as claimed in claim 51, wherein the stepped lens with the diffusing screen defines a light mixing system which alters the proportion of the scattered light relative to the proportion of the geometrical-optically imaged light, hence the light mixing

ratio, in a manner dependent on the position of the stepped lens spotlight.

53. The stepped lens spotlight as claimed in claim 51 or 52, wherein the stepped lens has a real focal point which can be superimposed with a focal point of the reflector that is remote from the reflector, in particular in the spot position of the stepped lens spotlight.

54. The stepped lens spotlight as claimed in one of the preceding claims from 51 to 53, wherein the stepped lens is a, preferably planoconvex, converging lens formed as a stepped lens.

55. A stepped lens spotlight having an adjustable aperture angle of the emerging light bundle having a, preferably ellipsoidal, reflector, a lamp and at least one stepped lens, as claimed in claim 51, wherein the stepped lens is a lens having a negative focal length, hence a negative lens having a virtual focal point.

56. The stepped lens spotlight as claimed in claim 55, wherein the stepped lens has a virtual focal point which can be superimposed with a focal point of the reflector that is remote from the reflector, in particular in the spot position of the stepped lens spotlight.

57. The stepped lens spotlight as claimed in claim 55 or 56, wherein the stepped lens is a preferably biconcave negative lens.

58. The stepped lens spotlight as claimed in one of the preceding claims from 51 to 57, wherein the aperture angle of

the light emerging from the stepped lens spotlight is less than or equal to 8° in the spot position and greater than or equal to 60° in the flood position.

59. The stepped lens spotlight as claimed in one of the preceding claims from 51 to 58, wherein the aperture angle of the light emerging from the stepped lens spotlight is less than or equal to 8° in the spot position and greater than or equal to 70° in the flood position.

60. The stepped lens spotlight as claimed in one of the preceding claims from 51 to 59, wherein the aperture angle of the light emerging from the stepped lens spotlight is less than or equal to 8° in the spot position and greater than or equal to 80° in the flood position.

61. The stepped lens spotlight as claimed in one of the preceding claims, wherein the stepped lens spotlight comprises an elliptic reflector having an ellipticity ε and the ratio of the focal length to the radius $n_{St1} = R_{St1}/F_{St1}$ of the stepped lens is greater than 0.5 times $1/\mathrm{sqrt}(\varepsilon^2-1)$, preferably greater than 0.7 times $1/\mathrm{sqrt}(\varepsilon^2-1)$, most preferably greater than 0.9 times $1/\mathrm{sqrt}(\varepsilon^2-1)$.

62. The stepped lens spotlight as claimed in one of the preceding claims from 51 to 61, wherein the reflector comprises a metallic or transparent, preferably dielectric material, glass and/or plastic.

63. The stepped lens spotlight as claimed in one of the preceding claims from 51 to 62, in which at least one of the two main surfaces of the reflector is provided with a system

of optically thin layers.

64. The stepped lens spotlight as claimed in one of the preceding claims from 51 to 63, in which the light-reflecting surface of the reflector, preferably having partial areas or facets, is structured in light-scattering fashion and no, one or two surfaces of the stepped lens are structured in light-scattering fashion in addition to the diffusing screen.

65. The stepped lens spotlight as claimed in one of the preceding claims from 51 to 64, wherein an auxiliary reflector is arranged between the stepped lens and the reflector.

66. The use of the stepped lens spotlight as claimed in one of claims from 51 to 65 for medicine, architecture, film, stage, studio and photography.

67. A flashlight comprising a stepped lens spotlight as claimed in one of the preceding claims from 51 to 65.